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(54) A spinal cage assembly

(57) The invention relates to a spinal cage assembly including a sleeve-shaped member of a metal compatible with the human body, said sleeve-shaped member having end faces defining irregular edges and having a wall provided with holes.

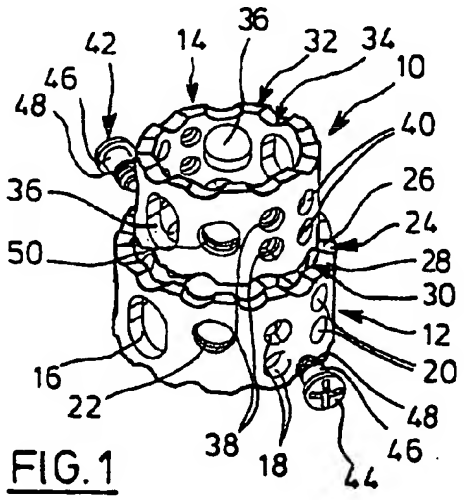

FIG. 1

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Description

The present invention relates to a spinal cage assembly.

Spinal implants have become known which are formed as hollow members and which are inserted - individually or in pairs - into the area between adjacent vertebrae in order to obtain effective adherence between adjacent vertebrae. Such implants are shown for example in European patent 0 307 741 B1, German patents 44 16 605 C1 and 43 23 956 C1, European patent application 0 637 440 A1, PCT-application WO 95/26164, US patent 5,015,247 and German utility model G 296 00 879. The hollow structure of the implants enables receival of bone material or the like for enhancing bone growth and adherence.

Furthermore so-called spinal cage assemblies have become known which are implanted for example after removal of a vertebra so as to replace the removed vertebra. Such spinal cage assemblies have become known for example from German utility model 91 07 494 and European patent applications 0 188 054 and 0 535 215. Such prior spinal cage assemblies engage the vertebrae in a substantially central area of relatively soft structure. Therefore, there is a risk of the spinal cage assembly „digging" into the vertebra.

A similar risk is present with spinal cage assemblies made of relatively thin wire mesh.

An object of the invention is to provide a spinal cage assembly allowing for effective support against and enabling growth of new bone substance between adjacent vertebrae.

To this end the invention provides a spinal cage assembly including a sleeve-shaped member of a metal compatible with the human body, said sleeve-shaped member having end faces defining irregular edges and having a wall provided with holes.

The spinal cage assembly of the present invention comprises a sleeve-shaped member of a material compatible with the human body. The sleeve-shaped member has a relatively thick wall suitable to receive and transfer substantial forces and enabling engagement with adjacent vertebrae under relatively small surface pressure. The support provided thereby is particularly effective when the diameter of the sleeve-shaped member is dimensioned such that the wall engages the vertebra in the cortical area thereof. As is known, the cortex is the hardest bone area.

In accordance with the invention the end faces or face edges of the sleeve-shaped member are of irregular shape. This prevents the sleeve-shaped member from rotary movements. Furthermore the wall of the sleeve-shaped member includes windows through which bone material may be inserted into the interior of the sleeve-shaped member.

Preferably, the irregular edge of the sleeve-shaped member extends in a plane which is inclined to a transverse axis of the sleeve-shaped member under a predetermined angle of e.g. 3 to 6°. This allows for adaption to different anatomic structures.

The end face of the sleeve shaped member may be provided with teeth and gaps therebetween, with the tips of the teeth being formed as planar surfaces such as to prevent the spinal cage assembly from digging into the vertebrae. Preferably, the gaps are of a round contour, with the gaps and the top surfaces of the teeth forming relatively sharp edges.

For assembly of a sleeve-shaped member a tool may be used, which has a relatively long shank and includes a threaded extension at a free end thereof. The threaded extension may be engaged into a threaded bore of the sleeve-shaped member in order to insert the latter into the space of the removed vertebra in a predetermined position between two adjacent vertebrae.

The height of the spinal cage assembly depends on the height of the removed vertebra or, respectively, the spacing between the remaining adjacent vertebrae, and on the position of the vertebra in the spine. Therefore, the prior art spinal cage assemblies generally are adjustable in height. In order to enable adjustments also with the spinal cage assembly of the present invention, it is preferred to provide a second sleeve-shaped member telescopically receiving the first sleeve-shaped member and being of similar shape as the internal sleeve-shaped member. Furthermore, both sleeve-shaped members include bores adapted to be aligned to each other and to receive threaded bolts for holding the two sleeve-shaped members stationary with respect to each other. When in this position the internal sleeve-shaped member projects somewhat from the external sleeve-shaped member. When a pair of bores is provided, two different relative positions may be set. Together with the height of the internal sleeve-shaped member there will result four different heights which will be completely sufficient for most of the cases occurring in practice. The height of the spinal cage assembly is adjusted before the implant is implanted so that difficult manipulations for height adjustment in situ are not required.

According to another aspect of the present invention a force member or the like may be mounted between the sleeve-shaped members telescopically received in each other in order to provide for automatic height adjustment. For example a biased spring may be provided to move the sleeve-shaped members apart from each other when a respective fixing means will be released. Other force members may be used.

While the sleeve-shaped member may be of square or polygonal cross-section, the circular cross-section in conformity with the contour of the vertebrae is preferred.

As already mentioned the tool for implanting the sleeve-shaped member has a relatively long shank. Such shank may rotatably receive a sleeve at its free end, which sleeve engages a shoulder of the shank and has at its free end a concave recess of a shape conforming to the shape of the external contour of the

sleeve-shaped member. In this manner transverse forces to be applied by the tool when the sleeve-shaped member is being implanted, are transferred not only via the relatively thin threaded extension but also via the sleeve.

The invention will be explained in more detail with reference to drawings.

Fig. 1 is a perspective view of a spinal cage assembly according to the invention;
Fig. 2 is a side elevation of the spinal cage assembly of Fig. 1 in a first direction;
Fig. 3 is a side elevation of the spinal cage assembly of Fig. 1 in the opposite direction;
Fig. 4 is an elevation of the spinal cage assembly of Fig. 1 in the assembled condition;
Fig. 5 is a side elevation of the internal sleeve-shaped member of the spinal cage assembly of Fig. 1;
Fig. 6 shows schematically a tool for handling the spinal cage assembly of Fig. 1;
Fig. 7 shows a detail in Fig. 6;
Fig. 8 is a cross-section of the sleeve of the tool of Fig. 6.

A spinal cage assembly 10 as shown in Figs. 1 to 4 comprises an external sleeve-shaped member 12 and an internal sleeve-shaped member 14. Both sleeve-shaped members 12, 14 have a relative thick wall, are made of a metal compatible with the human body, preferably titanium, and are of a circular cross-section. The dimensions are such that the sleeve-shaped member 14 is telescopically received in the external sleeve-shaped member 12. Furthermore the diameters of the external sleeve-shaped member 12 and the internal sleeve-shaped member 14 are selected such that the spinal cage assembly is supported substantially against the cortex when it is positioned between adjacent vertebrae. The shown spinal cage assembly is suited primarily for lumbal vertebrae.

The external sleeve-shaped member 12 includes a pair of elongated windows shown at 16 in Figs. 1 and 3. They can be used for inserting bone material.

The external sleeve-shaped member includes further eight radial holes 18 and 20 positioned in pairs one above the other. The holes of one pair are positioned above each other along an axis parallel to the longitudinal axis of the sleeve-shaped member 12. The holes of adjacent pairs 18, 20 are offset with respect to each other as may be best seen in Figs. 2 and 3.

Finally the sleeve-shaped member 12 includes a pair of threaded bores one of which is shown at 22. The purpose of the various holes or bores in the wall of the sleeve-shaped member 12 will be explained in more detail below.

The sleeve-shaped member 12 has at its upper and lower sides circumferentially uniformly spaced teeth 24 having flat upper surfaces 26. Gaps 28 of circular arc-shape are provided between the teeth and define together with the teeth relatively sharp edges in the area of the upper surfaces 26. Therefore, the upper and lower sides of the sleeve-shaped member prevent rotary movements thereof when it is implanted so as to provide a rotation preventing means.

The internal sleeve-shaped member 14 is of similar shape as member 12 and has upper and lower sides provided with teeth 32 and rounded gaps 34. The internal sleeve-shaped member 14 includes also pairs of windows 36 which are of elongated shape and can be aligned to the windows 16. Furthermore, the internal sleeve-shaped member 14 includes four threaded bores positioned in pairs one above each other, of which two pairs 38, 40 may be seen in Fig. 2. The bores of each pair are positioned vertically above each other. The bores of each pair may be aligned to the holes of a pair 18, 20 of the external sleeve-shaped member 12. Two screws or threaded bolts 42, 44 may be inserted into the holes 18 and 20, respectively. A smooth portion 46 thereof will be positioned in a hole 18 or, respectively, 20, while a threaded portion 48 may be engaged into the respective threaded bore 38 or 40, respectively, in order to hold the internal and external sleeve-shaped members 14, 12 stationary with respect to each other as shown in Fig. 4. Since the holes or bores of the pairs 18, 20 and, respectively, the pairs 38, 40 are offset with respect to each other in height, different relative positions of the internal and external sleeve-shaped members may be set. When for example the lowest bore of the pair 38 is aligned with the lowest hole of pair 18, the internal sleeve-shaped member 14 projects only slightly from the external sleeve-shaped member 12. When, however, the upper bore of pair 40 is aligned to the upper hole of pair 20, the internal sleeve-shaped member 14 projects maximally from the external sleeve-shaped member 12.

The internal sleeve-shaped member 14 includes further threaded bores 50 of which one is shown in Fig. 1 and two are shown in Fig. 2. The threaded bores 50 serve - in the same manner as threaded bores 22 - for connection with a tool shown in Figs. 6 to 8 as will be explained in more detail below.

The internal sleeve-shaped member 14 has an inclined upper surface as shown in Fig. 3. Fig. 5 shows the internal sleeve-shaped member 14 separately. As may be seen the upper surface is inclined to a transverse axis under an angle a of 6° and the lower surface under an angle b of 3°. Depending on which end of the internal sleeve-shaped member 14 is inserted first into the external sleeve-shaped member, a respective inclination of the upper surface will result. This allows for adaptation to respective anatomic geometries.

It will be appreciated that an internal sleeve-shaped member 14 or an external sleeve-shaped member 12 alone may be used.

Figs. 6 to 8 show a suitable assembly tool 52 having a handle 54, a shaft 56 of a length of e.g. 20 cm and an

extension 58 of a reduced diameter at the forward end. As is apparent from Fig. 7 the extension 58 has a threaded portion 60 at its free end. A sleeve 62 is mounted on the extension and has a bore with an internal threaded portion 64 extending to the left hand end while being spaced from the right hand end. The right hand or free end of the sleeve 62 has a concave recess 66 which is of a shape conforming to the round contour of the internal sleeve-shaped member 14 or the external sleeve-shaped member 12. During assembly, the sleeve 76 is threadingly engaged on the threaded portion 60 of the extension 58 and will then have one end engage a respective shoulder 68 of shaft 56. As a result, the sleeve 62 is mounted for rotation, however, fixed against axial displacement by the threads and may be removed only by unscrewing. When the tool will be connected to the spinal cage assembly of Figs. 1 to 5, the threaded portion 60 of the extension 58 will be threaded into the threaded bore 22 or threaded bore 50, with the sleeve 62 being rotated such that it will matingly engage the external side of the sleeve wall. This allows to transmit forces from shank 56 to the spinal cage assembly.

Claims

1. A spinal cage assembly including a sleeve-shaped member (12,14) of a metal compatible with the human body, said sleeve-shaped member having end faces defining irregular edges and having a wall provided with holes (16,36).

2. A spinal cage assembly as defined in claim 1, wherein said irregular edge of at least one of said end faces is inclined to a transverse axis of said sleeve-shaped member (14) under a predetermined angle.

3. A spinal cage assembly as defined in claim 2, wherein said predetermined angle is between 3° and 6°.

4. A spinal cage assembly as defined in claim 1, wherein said irregular edges are provided with teeth (24,32) and gaps (28,34) therebetween.

5. A spinal cage assembly as defined in claim 4, wherein said teeth (24,32) have tips formed as planar surfaces (26).

6. A spinal cage assembly as defined in claim 5, wherein said gaps (28,34) are of circular arc shape, said gaps and said planar surfaces (26) defining relatively sharp edges therebetween.

7. A spinal cage assembly as defined in claim 1, wherein said wall includes elongated holes (16,36) having longitudinal axes substantially parallel to a longitudinal axes of said sleeve-shaped member (12,14).

8. A spinal cage assembly as defined in claim 1, wherein said wall includes at least one threaded bore (22,50) for receiving a positioning tool (52) comprising a threaded extension (58,60) at a free end thereof.

9. A spinal cage assembly as defined in claim 1, wherein said sleeve-shaped member comprises an internal sleeve-shaped member (14) and an external sleeve-shaped member (12) telescopically receiving said internal sleeve-shaped member, said external and internal sleeve-shaped members (14,12) being adapted to be fixed in different hight positions.

10. A spinal cage assembly as defined in claim 9, wherein said external sleeve shaped member (14) includes at least two circumferentially spaced radial holes (18,20), said internal sleeve-shaped member (14) includes at least two circumferentially spaced threaded bores (38,40) adapted to be aligned to said radial holes (18,20) of said external sleeve-shaped member (12) such that said internal sleeve-shaped member (14) partially projects from said external sleeve-shaped member (12), said external sleeve-shaped member (12) has end faces formed as irregular edges, and said radial holes (18,20) and threaded bores (38,40) are adapted to receive threaded bolts (44,46) so as to hold said internal and external sleeve-shaped members (14,12) stationary with respect to each other.

11. A spinal cage assembly as defined in claim 10, wherein two or three pairs of radial holes (18,20) and threaded bores (38,40) are provided, the holes and, respectively, bores of each pair being disposed above each other along an axis parallel to a longitudinal axis of said external sleeve-shaped member or, respectively, internal sleeve-shaped member.

12. A spinal cage assembly as defined in claim 9, wherein a force member acts between said external and internal sleeve-shaped members so as to enable adjustment thereof in height, and fixing means are provided to fix said sleeve-shaped members in their respective positions.

13. A spinal cage assembly as defined in claim 9, wherein said external sleeve-shaped member (12) includes at least one radial threaded bore (22) for receiving a positioning tool (52) comprising a threaded extension (58,60) at a free end thereof.

14. A spinal cage assembly as defined in claim 9, wherein said sleeve-shaped member (12) has a

wall provided with radial windows (16).

15. A spinal cage assembly as defined in claim 9, wherein said internal and external sleeve-shaped members (14,12) are of circular cross-section.

16. A spinal cage assembly as defined in claim 9, wherein said threaded bolts (42,44) comprise a head and a stem, said stem comprising a threaded portion (48) and a cylindrical portion (46) arranged between said threaded portion and said head and being of a diameter corresponding substantially to the diameter of said radial holes (18,20) of said external sleeve-shaped member (12).

17. A tool for a spinal cage assembly as defined in claim 9, including an elongated shank (56) having a handle (54) at one end thereof and a threaded extension (60) at another end thereof.

18. A tool as defined in claim 17, wherein a sleeve (62) is rotatably mounted upon said threaded extension (68) so as to cooperate with a shoulder (68) of said elongated shaft (56) at an end thereof remote from said threaded extension (60), and includes a concave recess (66) of a shape conforming to the rounded shape of said internal or, respectively, external sleeve-shaped member (14,12).

19. A tool as defined in claim 18, wherein said threaded extension (60) includes a smooth portion (58) and said sleeve (62) has an internal threaded portion (64) spaced from a free end thereof, said internal threaded portion (64) being out of engagement with the threads of said threaded extension (60) when said sleeve (62) engages said shoulder (68).

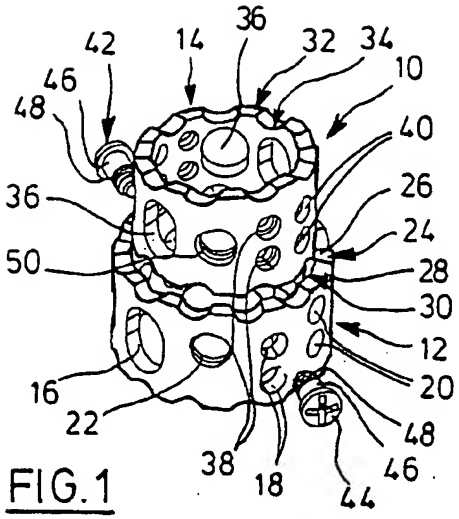

FIG.1

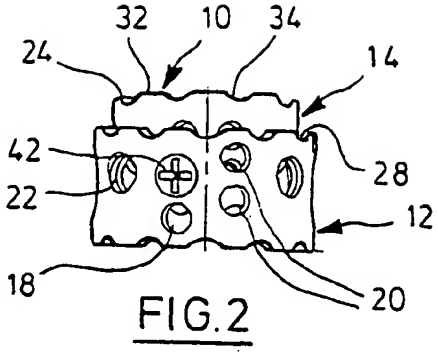

FIG.2

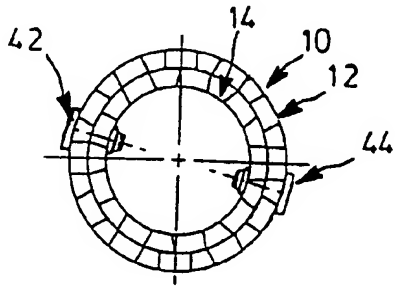

FIG.4

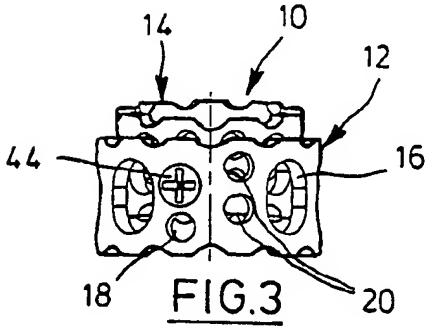

FIG.3

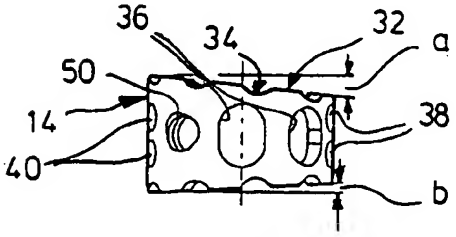

FIG.5

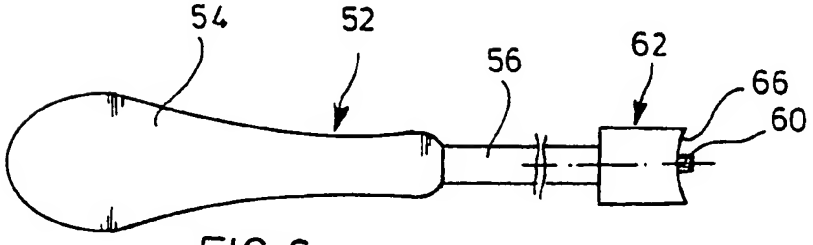

FIG.6

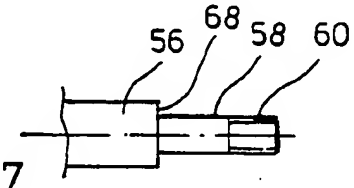

FIG.7

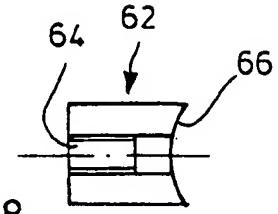

FIG.8